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Review Article

Effectiveness of behavioural interventions to influence COVID-19 outcomes: A scoping review

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ABSTRACT

Behavioural non-pharmaceutical interventions (NPIs) (e.g., mask wearing, quarantine, restriction on gatherings, physical distancing) have been used to interrupt transmission of COVID-19 and to reduce the impacts of the pandemic. The aim of this scoping review was to document the efficacy of behavioural NPIs to positively influence COVID-19 outcomes. Following PRISMA guidelines, a systematic search was conducted of PubMed, ScienceDirect, Psych INFO, Medline, CINAHL and Scopus for studies published between January 2020 and February 2023. Seventy-seven studies were eligible to be included in the review. Majority of the studies were conducted in high-income countries, with fewer studies in low- or middle-income countries. School closure, mask wearing, and non-essential business closure and shelter-in-place orders were the most prevalent NPIs investigated. School closure and mask wearing reported high effectiveness while shelter-in-place orders reported less effectiveness. Shelter-in-place orders when used in conjunction with other measures, did not enhance effectiveness. Public event bans, physical distancing, handwashing, and travel restrictions were largely effective, while the effectiveness of gathering restrictions depended on the limitation on numbers. Early implementation was associated with a higher effectiveness in reducing COVID-19 cases and deaths, the use of behavioural NPIs in combinations was reported to yield more effective results. Moreover, behavioural NPIs were reported to be dependent on their consistent use and were difficult behaviours to maintain, highlighting the need for behavioural change. This review highlighted the effectiveness of behavioural NPIs to positively influence COVID-19 reduction outcomes. Further research to promote country- and context-specific documents that will enhance the effectiveness of behavioural NPIs.

1. Introduction

Since its identification in early 2020, COVID-19 has spread globally and has currently infected >526.55 million individuals worldwide and has resulted in approximately 6.28 million deaths (World Health Organisation, 2022). At the onset of the pandemic, and in the absence of an effective vaccine against the disease, governments and the World Health Organization promoted the use of nonpharmaceutical interventions (NPIs) that required behaviour change, such as social distancing measures and mask wearing to prevent the spread of COVID-19 (World Health Organization, 2020a; World Health Organization, 2020b). The effectiveness of these behavioural NPIs has been largely dependent on the willingness of individuals to change behaviours (Coroiu et al., 2020). Fortunately, several vaccines have since been developed and approved for use for clinical and commercial use (World

Health Organisation, 2020). Vaccines have proven to be efficacious in reducing the spread and severity of disease (Yan et al., 2021). However, vaccination rates against COVID-19 remain lower low and middle-income regions. This is, in part can be attributed to vaccine hesitancy and challenges in the equity of the distribution of the vaccines (Asundi et al., 2021; Loembé and Nkengasong, 2021; Kabakama et al., 2022). Confirming this, as of 14 February 2023 only 26.4% of people living in low and middle income countries (LMICs) had received one dose of a COVID-19 vaccine (Mathieu et al., 2021; Mathieu et al., n.d.). As such, the use of NPIs in LMICs remains essential to curb the spread of the virus.

Research on the effective implementation of NPIs anchored in behavioural change principles, is integral not only for application in forecasted future pandemics, but also for use in addressing other global challenges such as climate change (Webster, 1997). However, behaviour change approaches and principles have not been systematically applied

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in the implementation of NPIs for COVID-19 prevention. Additionally, at a national policy level there exists limited guidance on behaviour change. A search for publicly available country level policy documents was conducted, and the findings are summarised in Table 1. Specifically, this search was aimed at identifying documents that provide a structured approach to achieving behaviour change in support of policy objectives. The United Kingdom is the only country with such a comprehensive document. We did not find any other government specific documents for other countries. However, we did find behavioural change documents for countries by non-governmental organisations such as USAID, United Nations, and European Union. Additionally, the Australian government has commissioned the development of a behaviour change document.

It is hence important to document the effectiveness of behavioural NPIs intended to positively influence COVID-19 outcomes to support their future implementation. The primary aim of this review was therefore to document the evidence of effectiveness of behavioural NPIs to positively influence COVID-19 outcomes. The secondary aim was to make recommendations on these interventions for research, policy, and practice. For the purposes of this review, behavioural NPIs included face masks, handwashing, and social distancing. Social distancing measures included physical distancing, school closures, border closures, public event bans, gathering bans, non-essential business closure, restricted movement, quarantine and stay-at-home orders. COVID-19 outcomes included the spread of infections, hospitalisation, and death (Hale et al., 2020).

2. Methods

In this review, we followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA). Databases searched included PubMed, ScienceDirect, PsychINFO, Medline, CINAHL and Scopus; the search was restricted to articles available in English from 1 January 2020 and 31 October 2021. All searches were done using different combinations of the following keywords COVID-19, corona virus, SARS CoV2, impact, effect*, evaluation, quarantine, isolation, masks, handwashing, hand sanitising, social distancing, physical distancing, and lockdown. Studies were included in the review if they:

- Assessed or compared behavioural NPIs effectiveness only in the context of COVID-19.
- Included at least one of the following NPIs, as described and categorised in the Oxford COVID-19 Government Response Tracker (OxCGRT) (Hale et al., 2020): Social distancing measures namely physical distancing, school closures, border closures, public event bans, gathering bans, non-essential business closure, restricted movement, quarantine and stay-at-home orders, and mask wearing policies.
- Were either observational or interventional (*i.e.*, quasi-experimental or experimental) studies of empirical data.
- Analysed NPI behavioural effectiveness in the general population of any geographical area.
- Directly measured the effect of the application of behavioural NPIs on any COVID-19 outcome (infection, hospitalisation, and death).

Studies were excluded from the review if they:

- Were based on forecasts.
- Did not assess the direct link between NPIs and the COVID-19 outcomes stipulated (for example, no direct link between COVID-19 outcome and NPI).
- Analysed the impact of adherence or compliance to NPIs.

Fig. 1 outlines the search, screening, and data extraction phases. One reviewer (TMS) screened all titles and abstracts, and second reviewer (CED) screened 10% of titles and abstracts, and discrepancies in decisions were discussed to reach consensus. One consensus was reached, TS

Table 1

Country level behaviour change documents for health promotion.

Country	Title	Year	Website and purpose
United Kingdom	Achieving behaviour change: a guide for national government.	2020	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/933328/UFG_National_Guide_v04.00_1_1_.pdf This document aims to provide a structured approach to achieving behaviour change in support of policy objectives. It is based on an interdisciplinary approach known as the Behaviour Change Wheel (BCW) that was developed by integrating 19 behavioural science frameworks from many disciplines and sectors.
United Nations	Behaviour changes strategies and health: the role of health systems	2017	https://sustainabledevelopment.un.org/content/documents/2404Behavioral%20Insights.pdf Through the development of country specific and disease specific guidelines, the United Nations aims to develop people centred policies to achieve effective program out puts.
India	COVID-19 Communication Handbook	2020	https://csbc.org.in/wp-content/uploads/2020/07/FINAL_CSBC-COVID-19-Communication-Handbook-09072020.pdf This non- governmental organization handbook aims to provide practical guidance on how to use behaviourally informed insights to design effective communication to address the rapid behaviour change needed during this pandemic.
Australia	Changing behaviour: a public policy perspective	2018	https://legacy.apsc.gov.au/changing-behaviour-public-policy-perspective Australia has commissioned a behaviour change document but does not have one currently. This document aims to provide evidence that behavioural theory and empirical research can add to the fundamental building block of behavioural change for policy makers.
Pan American Health Organisation	Building better health: a handbook of behavioural change	2003	https://iris.paho.org/bitstream/handle/10665.2/706/9275115907.pdf?sequence=2&isAllowed=y This book was written independently for Pan American countries. It promotes the use of behavioural sciences in conjunction with disease prevention practices to improve health.
New Zealand - Group	New Zealand Guideline	1998	https://www.health.govt.nz/system/files/documents (continued on next page)

Table 1 (continued)

Country	Title	Year	Website and purpose
European Union	Behavioural Insights Applied to Policy	2016	<p>/publications/effective-health-behaviour-change-long-term-conditions.pdf</p> <p>The document aims to provide guidelines for effective health behaviour change interventions for people with long-term conditions.</p> <p>https://ec.europa.eu/jrc/sites/jrcsh/files/jrc-bia-p2016-italy_en.pdf</p> <p>The document was compiled by the European Union for Italy. It aims to highlight the importance of the use of behavioural insights to policy making. It showcases examples of behavioural interventions in a range of policy areas, such as employment, consumer policy, health, taxation, environment, or transport, pointing to their respective outcome whenever this was available.</p>
USAID	Tools for behaviour change communication	2021	<p>https://www.usaid.gov/what-we-do/global-health/cross-cutting-areas/social-and-behavior-change</p> <p>This handbook highlights the importance of the use of behaviour change techniques in improving health.</p>

Witwatersrand (Ref: H21/10/06).

3. Results

The details of the studies included are presented in Table 2. A significant proportion of the studies were conducted in high-income countries (HICs, 58%), with only 15% of studies in low-income countries. The methodologies used in the articles were observational and quasi experimental studies (63%), modeling studies (33%), case control studies (3%), and randomized controlled trial (1%). The number of participants in the studies varied substantially, from hundreds to millions of participants. Observation time varied among the studies, even among studies done in the same country. Most of the studies were on the effectiveness of social distancing measures ($n = 71$), followed by the effectiveness of mask wearing ($n = 26$); very few were on hand sanitising ($n = 5$). Some studies evaluated the effect of both social distancing measures and mask wearing concurrently. Only one study made use of behavioural principles in the application of behavioural NPIs (Abaluck et al., 2021).

In relation to the measures used to evaluate the effect of social distancing measures on COVID-19 outcomes, most studies used regression models and estimated compartmental models to estimate infection, death, or hospitalisation rates, while others evaluated changes in the reproduction number (R_t). The studies on hand sanitising and mask wearing mainly evaluated infection rates, or the assessment of relative risk. Some studies used more than one of the evaluation measures (R_t , infection, or death rates). The definition of social distancing varied; some studies considered social distancing as a combination of certain restrictions (Lemaitre et al., 2020; Kaufman et al., 2021; Alimohamadi et al., 2020; Cruz, 2020; Delen et al., 2020; DePhillipo et al., 2021; Durmuş et al., 2020; Fazio et al., 2021; Qureshi et al., 2021; Reis et al., 2020; Ryu et al., 2021; Zhang et al., 2020; Siedner et al., 2020; Bo et al., 2021; Ghanbari et al., 2020), while some studies considered social distancing as the encouragement given by governments to keep a prescribed physical distance between individuals. Doung-Ngern et al. (2020) reported that keeping a physical distance was effective in reducing COVID-19 impacts. Similarly, all studies that assessed the effectiveness as a social distancing as a mix of measures reported effectiveness. Supporting this, Gallaway et al. (2020) highlighted that the implementation of behavioural NPIs in combinations yielded greater effectiveness. In a study done in Europe by Flaxman and his colleagues a combination of interventions reduced R_t below 1 (probability $R_t < 1.0$ is >99%) (Flaxman et al., 2020).

The most prevalent behavioural NPI to be assessed were lockdowns ($n = 18$), non-essential business closures ($n = 26$) and school closure ($n = 21$). Twenty out of the twenty-one studies on school closure reported significant effectiveness with Li et al. (2021), Liu et al. (2021), Brauner et al. (2021), Esra et al. (2020), Courtemanche et al. (2021), Hunter et al. (2020), Nader et al. (2021) reporting that this behavioural NPI was highly effective in reducing COVID-19 negative outcomes. Non-essential business closure was largely effective, with seventeen of the twenty-one studies reporting effectiveness. Brauner et al. (2021) and Banholzer et al. (2021) in their studies reported that it was the most effective behavioural NPI in reducing the impact of COVID-19. In contrast, lockdowns or stay at home measures reported mixed effectiveness. Koh et al. (2020) reported that strict lockdowns were not as effective as non-essential business closures in curbing the spread of COVID-19. While Brauner et al. (2021) highlighted that in their study the effect of lockdowns was not seen when other behavioural NPIs were in place. However, other studies (Esra et al., 2020; Ebrahim et al., 2020; Courtemanche et al., 2021; Dreher et al., 2021) reported that lockdowns were highly effective, with Flaxman et al. reporting that lockdowns were the only behavioural NPI to reduce the reproduction number below one (Flaxman et al., 2020). Ebrahim et al. (2020) also reported that partial lockdowns, were as effective as complete lockdowns in reducing the impact of COVID-19. Furthermore, though lockdowns were effective in

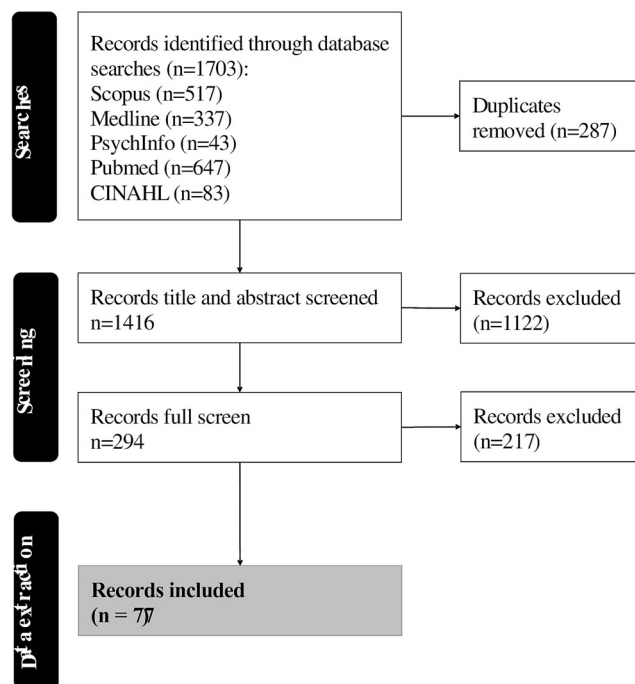







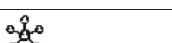




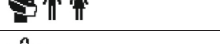







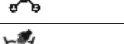
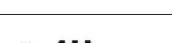


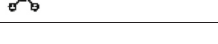


Fig. 1.. Search strategy for studies on the effectiveness of behaviour change interventions influence on COVID-19 outcomes.

























conducted full text screening and data extraction.

























Ethical approval for the study was obtained from the Human Research Ethics Committee (Non-Medical) at the University of the

Table 2

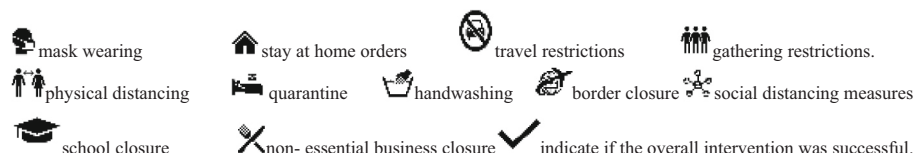
NPI study details (Alfano, 2022; Andrejko et al., 2022; Dave et al., 2021; Dzator et al., 2022; Figueiredo et al., 2020; García-García et al., 2022; Ghosal et al., 2020; Guzzetta et al., 2020; Hendrix, 2020; Herstein et al., 2021; Hyafil and Morina, 2020; Islam et al., 2020; Karaivanov et al., 2020; Kwon et al., 2021; Lyu and Wehby, 2020; Mitze et al., 2020; Olney et al., 2021; Pozo-Martin et al., 2021; Rader et al., 2021; Saez et al., 2020; Saki et al., 2021; Scott et al., 2021; Sharif et al., 2021; Silva et al., 2020; Singh et al., 2021; Sypsa et al., 2021; Tran et al., 2021; Triukose et al., 2021; Van Dyke et al., 2020; Wagner et al., 2020; Wang et al., 2020; Woskie et al., 2021; Yang et al., 2021; Zhang and Warner, 2020; Zhou, 2021).

Source	Location	Behavioural Intervention	Outcome
Abaluck (1)	Bangladesh		✓*
Alfano (2)	40 European countries		✓
Alfano (3)	47 European countries		✓
Alimohamadi et al(4)	Iran		✓
Andreyko (5)	USA		✓
Banholzer et al(6)	USA, Canada, Australia, Switzerland, Norway, the 15 European Union countries.		✓
Bo et al(7)	190 countries		✓
Brauner et al (8)	40 countries		✓
Bundgaard(9)	Denmark		✗
Castaneda(10)	USA-154 counties Texas		✓
Courtemanche et al(11)	USA 2477 counties		✓
Cowling et al(12)	Japan		✓
Cruz(13)	Brazil		✓
Dave (14)	USA		✓
De Brouwer et al(15)	China, Belgium, Italy, Spain		✓
Deb et al (16)	129 countries		✓
Delen et al(17)	26 European Union countries		✓
De Phillipo et al (18)	USA country wide		✓
Doung-Ngern et al (19)	Thailand		✓
Dreher et al(20)	USA 48 states and the district of Colombia		✓
Durmus et al (21)	Turkey		✓
Dzator (22)	World wide		
Ebrahim et al (23)	USA- 1320 counties		✓
Esra et al(24)	Worldwide, 26 countries and 34 US states		✓
Fazio et al(25)	USA		✓

Flaxman et al (26)	Europe - 11 countries		✓
Gallaway et al(27)	Arizona, USA		✓
Garcia-Garcia (28)	Spain		✓
Ghanbhari et al (29)	Iran		✓
Ghosal et al (30)	India, Italy, UK, Spain, France, Germany, Austria, Belgium, Hungary, Poland, New Zealand, Malaysia		✓
Guzzetta et al(31)	Italy		✓
Hendrix et al(32)	Missouri, USA		✓
Herstein, J. J. et al (33)	Nebraska, USA		✓
Hunter et al(34)	30 European Union countries		✓
Hyafil et al(35)	Spain		✓
Islam et al(36)	149 countries		✓
Karaivanov et al (37)	Canada		✓
Kaufman(38)	USA- 50 US states		✓
Koh et al(39)	142 countries		✓
Kwon (40)	USA		✓
Lemaitre et al(41)	Switzerland		✓
Lio	China		✓
Liu et al (42)	130 countries		✓ X
Liu et al (43)	USA		✓
Loewenthal (44)	37 OECD member states		✓
Lyu and Wehby (45)	USA 2930 counties		✓
Medeiros de Figueiredo et al(46)	China		✓
Megarbane (47)	New Zealand , France, Spain, Germany, Netherlands, Italy, UK, Sweden, USA		✓
Milazzo (48)	Australia		✓

Mitze et al(49)	Germany		✓
Nader et al(50)	176 countries		✓
Olney (51)	USA		✓
Piovani (52)	37 OECD countries		✓
Pozo- Martin et al (53)	37 OECD member states		✓
Qureshi, A. et al(54)	78 countries 41 states		✓
Rader et al (55)	USA 12 states		✓
Reis et al(56)	Brazil, Italy, South Korea		✓
Ryu(57)	South Korea		✓
Saez et al(58)	Spain, China, South Korea, Italy		✓
Sanchez (59)	USA		✓
Scott et al (60)	Melbourne, Australia		✓
Sharif (61)	Bangladesh		✓
Siedner et al(62)	USA		✓
Silva et al(63)	Brazil		✓
Singh et al (64)	USA		✓
Stokes (65)	130 countries		✓
Sypsa et al (66)	Greece		✓
Tran (67)	USA		✓
Triukose (68)	Thailand		✓
Van Dyke et al(69)	USA		✓
Verma (70)	USA, Italy, UK, India, France, Russia		✓
Wagner (71)	USA		✓
Wang et al (72)	Beijing, China		✓

Woskie et al (73)	Europe		✓
Yang et al(74)	New York, USA		✓
Zhang et al (75)	USA		✓
Zhang et al(76)	China, Italy, USA		✓
Zhou et al (77)	USA		✓



*behavioural principles applied

*behavioural principles applied

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reducing mobility to grocery stores, schools, business, workplaces etc., Delen et al. (2020) reported that during lockdowns there was increased residential mobility.

Public event bans were found to be effective in 66% of the studies. Li et al found in their study that this behavioural NPI was the most effective, reducing the reproduction number by 25%, 28 days after its implementation (Li et al., 2021). Most studies reported that gathering restrictions were largely effective in reducing the impacts of COVID-19. Nonetheless, Brauner et al highlighted that the effect of gathering restrictions was dependent on the numbers limited. Their study reported a large effect size for limiting gatherings to 10 people or less, a moderate-to-large effect for 100 people or less, and a small-to-moderate effect for 1000 people or less (Brauner et al., 2021). Moreover, both internal and international travel restrictions were associated with a reduction in the reproduction number, growth rate or incidence-related outcomes in 73% of the studies.

Some studies (Koh et al., 2020; Loewenthal et al., 2020; Deb et al., 2020; Mégarbane et al., 2021; Piovani et al., 2021; Stokes et al., 2022; Sanchez et al., 2022; Verma et al., 2020) highlighted that the effectiveness of the behavioural NPIs was dependent on the timing of their implementation, emphasising the need for early implementation. Loewenthal et al. (2020) highlighted in their study that a 7.49 day delay in lockdown implementation resulted in doubled deaths. Other studies (Nader et al., 2021; De Brouwer et al., 2020; Milazzo et al., 2022) reported that the effect of behavioural NPIs was not immediate and had a more gradual effect on COVID-19 health outcomes, with Alfano and Ercolano (2020) reporting efficacy detectable 100 days after implementation. Few studies assessed the effectiveness of hand sanitising; Lio et al. (2021) reported that hand sanitising reduced the odds of infection after an outdoor activity (adjusted odds ratio (OR), 0.021 [95% confidence interval (CI), 0.003–0.134], $P < 0.005$). In the same study handwashing before touching the mouth and nose area also reduced the odds of infection (OR, 0.303 [95% CI, 0.114–0.808], $P < 0.05$) (Lio et al., 2021). Moreover, the effectiveness of handwashing was directly linked to the duration of handwashing (Lio et al., 2021).

Twenty-six studies analysed the effect of wearing masks on the variation of infection rates and transmission rates (Table 2 and supplementary tables). Most studies reported that wearing masks was effective in reducing the transmission rates of COVID-19. In Thailand, mask wearing was associated with a 77% reduced infection risk (adjusted odds ratio, 0.23 [95% CI, 0.09–0.60]) (Doung-ngern et al., 2020). However, a study in Denmark reported that the mask wearing while other measures were in place, did not further reduce the COVID-19 infection rate among wearers by >50% (Bundgaard et al., 2021). Though overall, mask wearing and other behavioural NPIs were found to be largely effective against COVID-19, mask effectiveness is reported to be affected by how individuals use them. Cowling et al. in their study reported that at the onset of the pandemic only half of the respondents in their study indicated that they could confidently implement the government mandated measures (Cowling et al., 2020). Furthermore, Doung-ngern et al. (2020) highlighted that wearing a mask all the time when in contact with others was effective, but not wearing a mask all the time did not lower risk of infection (Doung-ngern et al., 2020). Additionally, Gallaway et al. (2020) in their study noted that both physical distancing and mask wearing were behaviours that were difficult to maintain.

4. Discussion

The findings of this scoping review contribute to the literature highlighting the effectiveness of behavioural NPIs as effective interventions to reduce transmission and mitigating the impact of the COVID-19 pandemic. It is likely that COVID-19 will become endemic (Torjesen, 2021) but because of vaccine inequality and low vaccine coverage and acceptance rates in low-or middle-income countries especially, the use of behavioural NPIs may remain integral to

prevention. Consequently, long-term behavioural adjustments will need to be made by the public. It has been argued that for effective application of behavioural NPIs in the public, there needs to be a complete change in the way the economy, business, and life (including home life) is organised, to protect vulnerable groups, such as the elderly, pregnant women and immune-compromised individuals (Regmi and Lwin, 2021).

Our findings highlight that behavioural NPIs are effective and furthermore, the use of a combination of multiple measures, e.g., school closure, business closure, gathering restrictions and travel restrictions appeared to be more effective in reducing the transmission, hospitalisation, and mortality due to COVID-19. Similar mitigation measures which aimed not to interrupt transmission completely, but to reduce the health impact of an epidemic were adopted by the United States in 1918, and by the world more generally in the 1957, 1968 and 2009 influenza pandemics, and were found to be effective (Ferguson et al., 2020; World Health Organization, 2006; Vukotich et al., 2010; Mitchell et al., 2011). However, of concern are the limited number of studies in LMICs on the effectiveness of behavioural NPIs. As behavioural NPIs remain vital in these low resource settings, more research needs to be done to understand the effectiveness of behavioural NPIs in these settings.

Some studies included in this review highlighted that strict stay-at-home orders or complete lockdown may not be necessary to mitigate COVID-19 spread. Complete lockdowns may have detrimental economic effects to those living in LMICs and hence employing other social distancing measures rather than strict lockdowns maybe of more benefit in low resource settings. For example, a study done in India on the impact of COVID-19 lockdowns on livelihoods of families found that during a hard lockdown, weekly household income dropped by 88% which resulted in significantly reduced meal portions and fewer food items consumed (Gupta et al., 2021).

The effectiveness of behavioural NPIs in both HICs and LMICs is made challenging by the fact that social distancing measures and mask wearing are not typically part of culture (Miguel and Mobarak, 2021). In addition, it is well documented that purposeful health behaviour change is both difficult to achieve and even more difficult to maintain (Bundy, 2004). Confirming this, Yeung et al. (2020) reported that though mask wearing was effective, only 13% of participants wore the masks as recommended, exposing individuals to possible infections. Moreover, Delen et al. (2020) showed that though lockdowns were effective in reducing mobility to business, recreation centres and other communal places, they also resulted in increased residential mobility.

While we have provided evidence of the effectiveness of behavioural NPIs to curb the spread of COVID-19, the public must be willing and able to use these behavioural NPIs. During the 1918 influenza pandemic Whitelaw (1919) made the following statement: “To sum up, it is evident, that no public health law, which has not the endorsement and support of the public generally, can ever be reasonably well enforced.” Hence, the use of a behavioural framework to plan interventions based on key country specific barriers, will ensure countries implement appropriate and targeted responses. As mentioned, the United Kingdom has a national health behaviour change document that makes use of the Behaviour Change Wheel (Michie et al., 2011). The guide supports policy makers in times of crisis (such as with the current pandemic), to develop or adapt interventions to suit the context. By using the acronym APEASE, the United Kingdom document ensures that the behavioural changes needed to be employed by the citizens are acceptable, practical, effective, affordable, considers possible side effects of the behaviour change, as well as promotes equity. Furthermore, this document considers factors such as capability, opportunity, and motivation of the adopters, when planning interventions. Considering the aforementioned acronym and factors when drafting policy allows for behavioural NPIs to be well thought through and may prevent the mandating of behavioural NPIs that cannot easily be applied in a specific setting. For instance, in African countries because of socioeconomic issues, the proposed behavioural NPIs measures are challenging to comply with and hence, this has led to some ignoring lockdown and quarantine policies and

engaging in communal activities to earn incomes for their families (Bundgaard et al., 2021; Castaneda and Saygili, 2020). Additionally, compared to higher income countries, most African countries have little governmental financial support being provided for local businesses (Mehtar et al., 2020; Musa et al., 2020; Abdool Karim, 2020). It is therefore evident that a one size fits all approach to pandemics may not be effective (Salihu Sabiu Musa et al., 2022). A country specific behaviour change document will also allow governments to construct precise messaging, which in turn will also promote social trust among their citizens which is needed to address any unprecedented challenge to the healthcare systems of nations. Lastly, as the effectiveness of behavioural NPIs is affected by their timing of implementation, having the government policies in place will facilitate the swift and effective implementation of behavioural NPIs.

To our knowledge, this is the first scoping review to examine the effectiveness of the implementation of behavioural NPIs to reduce transmission of COVID-19 in conjunction with a search of government behavioural change policy documents for pandemics. Several factors limited the present study. Our search strategy was limited to the adult population (>18 years), and we were unable to review grey literature. Secondly, identified studies are variable in sample size, quality, and study population. Most of them had some methodological weaknesses and were open to bias, and the heterogeneity of data precludes a meaningful meta-analysis to measure the impact of specific enablers or barriers. However, given the nature of the pandemic, and that many of these studies would have been in rapid response to the research need, we believe these findings can still provide insights into the effectiveness of behavioural NPIs to reduce transmission of COVID-19.

5. Conclusions

Our review has highlighted the importance of behavioural NPIs for reducing COVID-19 infection in the context of global uncertainty. Behavioural NPIs are a complex form of intervention, that require the participation and behaviour change of the public. This review has identified that implementing behavioural NPIs, e.g., social distancing and mask wearing, are generally effective and one of the best ways for preventing or reducing transmission. This study, however, suggests that the effectiveness of any behavioural NPIs in isolation is likely to be limited, therefore, a combination of multiple measures appeared to be more effective in reducing COVID-19. In addition to this the study highlights the importance of the application of behaviour change principles when implementing NPIs.

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1. Conceived and/or designed the work that led to the submission, acquired data, and/or played an important role in interpreting the results.
2. Drafted or revised the manuscript.
3. Approved the final version.
4. Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Declaration of Competing Interest

The authors declare no conflict of interest.

Data availability

Data will be made available on request.

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